

# How do different organic materials effect the pH of soil within a week



**examination period**  
**Kacie Dale and Lola Lenavitt**  
*Ottawa Hills High School*



## Abstract

- which variables can affect the pH of soil the most significantly
- more commonly found for the variable to increase the pH
- we tested the effect on the pH of dirt when mixed with pH altering variables
- we found baking soda had the most significant effect on the pH. Followed by coffee and eggshells with little change to the pH
- our hypothesis was proven to be incorrect however, these results overall matched our predictions for all but one variable

## Research Question

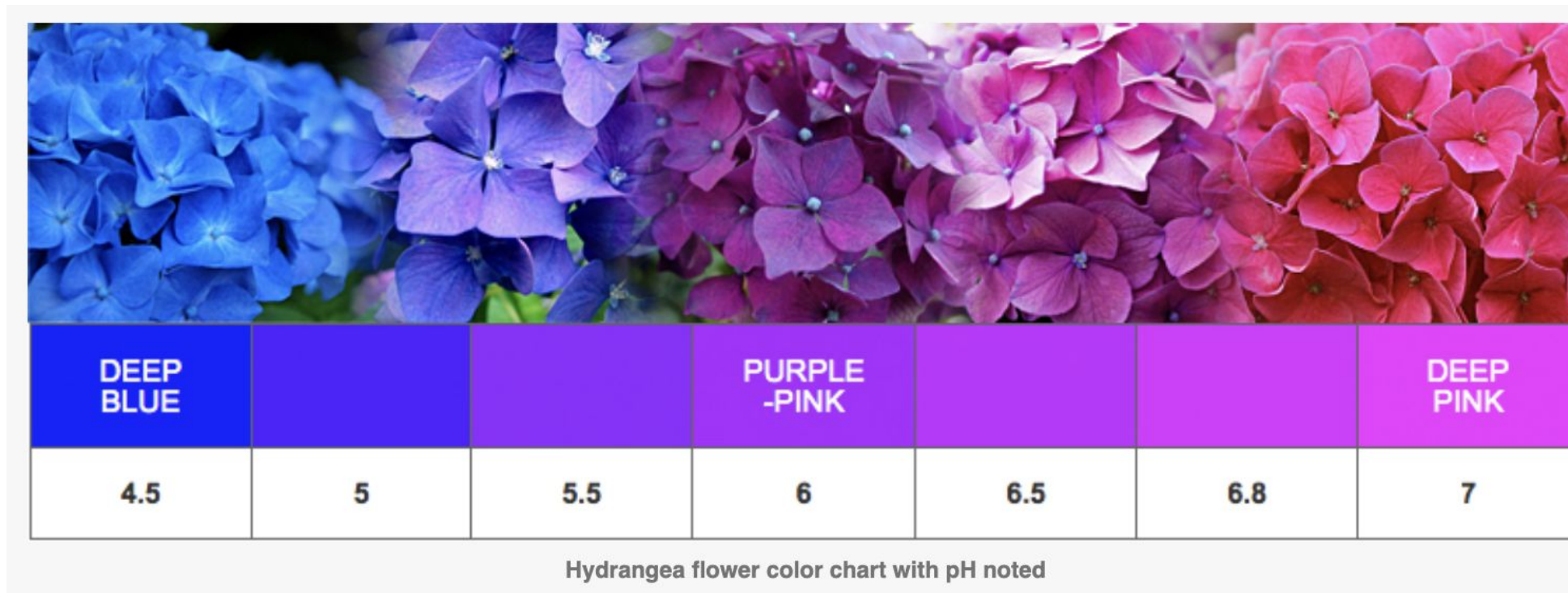
### Asking Questions

- Explains why this is an important question and of scientific interest
- Involves an aspect of Earth's environment about a local or global issue
- Considers ideas that previous investigations did not address
- Reflects in-depth knowledge of the content area
- Question is clearly stated
- Are answerable through scientific research appropriate to the scope of the report (i.e., scientifically testable)

## Introduction

### Content Knowledge

- We chose to observe which materials will alter the PH of soil the most after a one week study.
- When environmental factors or manmade factors are added to the mix it can affect the pH of soil resulting in changes to plants
- we will be testing the effect on pH with the additions of eggshells, coffee, lemon juice, and baking soda on natural soil as well as measuring what the PH of just regular soil.
- we will use our data to come to the conclusion of how florists can gain more control over the colors of their flowers.
- "Lemon juice, due to its citric acid, lowers soil pH, making it more acidic."
- Baking soda or sodium bicarbonate is a natural base, so when we add it into soil it will increase the PH of our soil.
- Pure unbrewed coffee grounds are highly acidic and work to lower the Ph of soil.
- Egg shells work to increase PH because they are made of mostly calcium carbonate, a natural alkaline compound, with a high pH of 8.4-8.75.



## Research Methods

### Planning Investigations

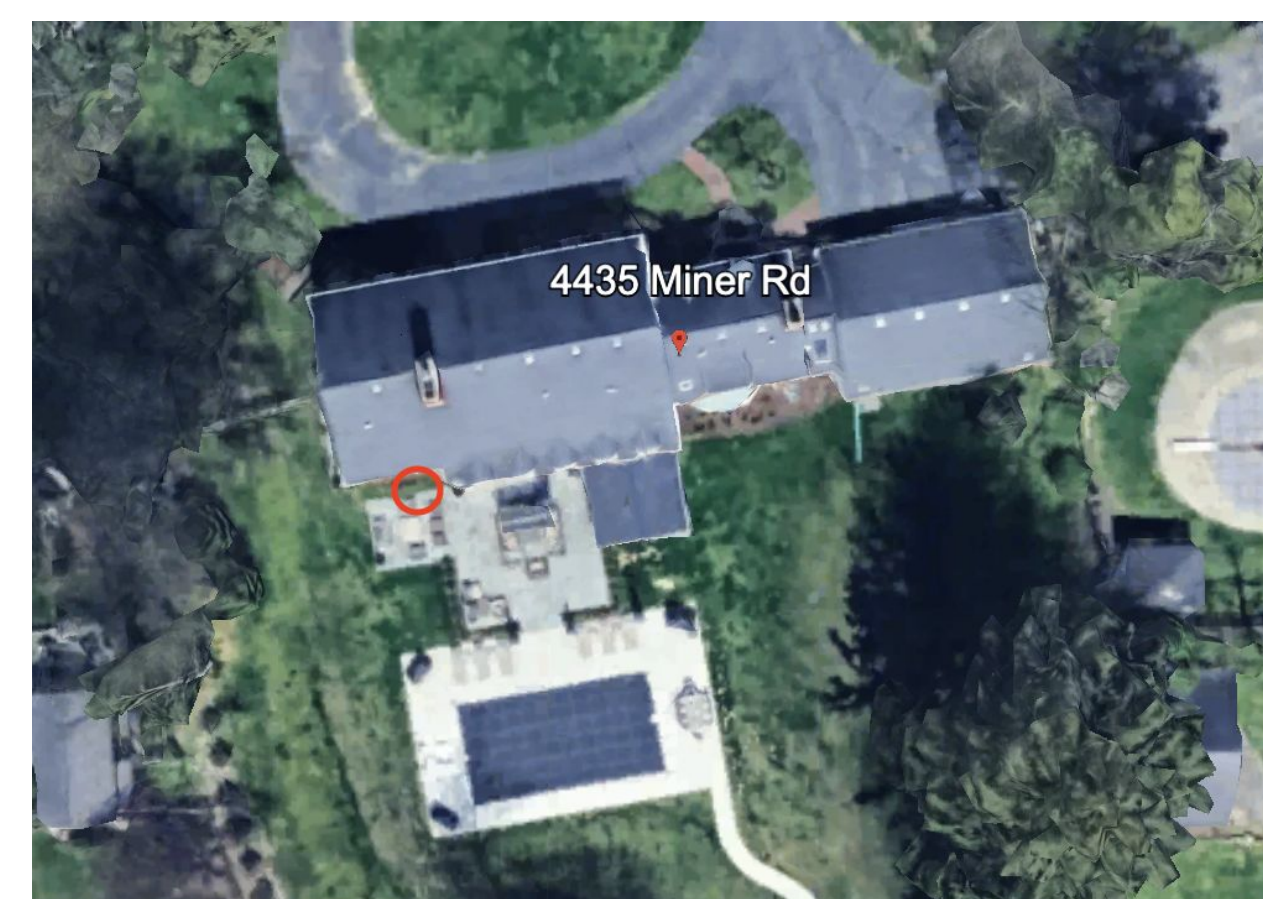
Describes the planning process

- used 200 mL beakers each with 20 g of soil, 10 mL of water, and 3.5 g of either eggshells, coffee, lemon juice, or baking soda
- one control group of 20 g of soil plain mixed with 10 mL of water
- measured 20g of soil on a scale, and placed it into a 200 mL beaker, measured 3.5g of our additives and added it into the beaker with our soil. Then, we added 10 mL of distilled water and used a stirring rod to stir and make sure the components were fully mixed
- done at room temperature with natural lighting, on a plane non-contact surface

### Carrying Out Investigations

Describes what happened

- we collected our data after one day, and one week by using a broad pH strip and then a more specific strip to get the most accurate p of each mixture
- Team member 1 tested each mixture with the broad strips and recorded it
- team member 2 usee the broad strips to identify which specific strip to use and proceeded to test each mixture with a narrow strip and record that data.
- We tested in a closed fume hood of our chemistry classroom



## GLOBE Badges

### Be a Collaborator

All team members are listed including students from the same school or schools from around the world, along with clearly defined roles, how these roles support one another, and descriptions of each student's contribution. The descriptions clearly indicate the advantages of the collaboration. If the students collaborated with students from another school, describe how working with other schools improved the research.

### Be a Data Scientist

The report includes in-depth analysis of students' own data as well as other data sources. Students discuss limitations of these data, make inferences about past, present, or future events, or use data to answer questions or solve problems in the represented system. Consider data from other schools or data available from other databases.

### Be an Earth System Scientist

The report clearly describes the interconnectedness of Earth's spheres on the research question and applies multiple GLOBE protocols, or GLOBE protocol bundles, to investigate the research question. The research team clearly explains the dynamic and interconnected nature of Earth's systems and the processes that influence and depend on one another through the analysis and interpretation of GLOBE and Earth system science data.

## Results

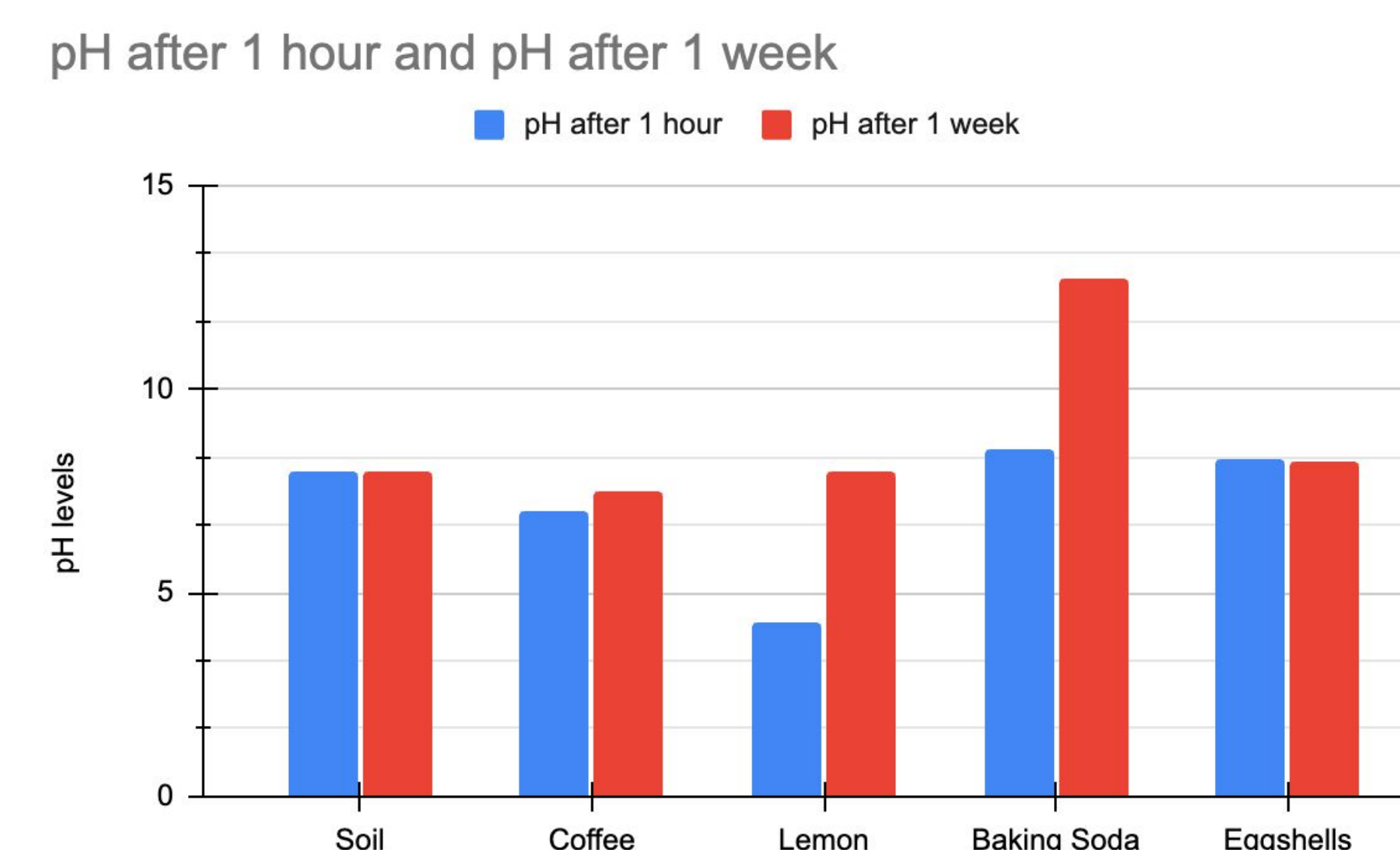
Our data we captured over a week-long period with specific pH strips demonstrates hows that certain organic additives high, or low in pH will alter the pH of soil when combined together.

- Soils pH remained the same at 8.0 throughout the experiment,
- coffees pH changed slightly from 7.0 to 7.5, proving it to be non beneficial for a great pH change
- Lemon offered a pH change of 3.7 however the pH changed from a acid to a base, we most likely believe that this was a result of the lemon juice molding, however the large shift makes it optimal for an organic pH shifting method.
- baking soda offered the highest change from 8.5 to 12.7, a shift of 4.2, making baking soda the most effective method in changing the pH of soil.
- Eggshells created a slight pH change from 8.3 down to 8.2 making it the least beneficial for a safe and organic way to change pH.

Figure #1

	Soil	Coffee	Lemon	Baking Soda	Eggshe lls
pH after 1 hour	8.0	7.0	4.3	8.5	8.3
pH after 1 week	8.0	7.5	8.0	12.7	8.2

Figure #2



## Discussion

### Interpreting Data

- Overall our results did not support the hypothesis because we expected lemon juice to have the most significant effect, but it turned out to have one of the least effects on the soil.
- According to our original base sources, baking soda and lemon juice performed the most accurately to what we expected, While coffee ground and eggshells performed similarly but not quite as much as to what we expected.
- We discovered an error with evaporation and mold when we came back to our experiment 1 week later. Next time we conduct this experiment we will use beaker covers to help prevent mold and evaporation.
- We obtained these results because from our background information and research we learned that the natural pH of soil is 6-7.5 since our sample of soil had a pH of 8.0 and was already a base we can conclude that some of our additives didn't change the pH very much because of that factor, however our materials that were very far left or right on the pH scale resulted in a huge change, more specifically lemon and baking soda.
- Our experiment accurately represented our hypothesis because we found out which material changed the pH the most, and we also concluded which material would be best for organic florists based on how much the material changed the pH.

## Conclusions

### Drawing Conclusions & Next Steps

- our hypothesis was tested false because we hypothesised lemon juice would alter the pH the most significantly.
- We successfully tested which independent variable had the biggest and smallest immediate and long term effects of the pH of the soil.
- If we were to do this experiment again, we would use covers to seal the air out and prevent molding
- If I had the opportunity to expand the testing on this experiment I would test more variables & test to see if the type of state of matter used has an effect on altering the pH.
- Our research can help local and widespread florists have more control over their products in order to be more efficient with their production which could eventually decrease prices by increasing efficiency.

## Bibliography References

- Iowa State University. (2006, January 5). *2006 Integrated Crop Management Conference - Iowa State University* — 235. Can ground eggshells be used as a liming source?. <https://www.agronext.iastate.edu/soilfertility/info/eggshell-lime.pdf>
- [How to Organically Raise pH in Soil | Kellogg Garden Organics™ \(n.d.\). Kelloggsgarden.com.](https://www.kelloggsgarden.com/blog/soil/how-to-organically-raise-ph-in-soil/)
- [Pokorny, K. \(2023, June 23\). Used appropriately, coffee grounds improve soil and kill slugs | Newsroom, Newsroom.](https://news.orcnstate.edu/news/used-appropriately-coffee-grounds-improve-soil-and-kill-slugs)
- [Ballato, L. \(2021, October 4\). CHANGING THE COLOR OF YOUR HYDRANGEAS - Lorraine Ballato, Lorraine Ballato.](https://www.lorraineballato.com/changing-the-color-of-your-hydrangeas/)